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SUBJECT IV
WETLANDS, CLIMATE CHANGE AND LIVELIHOODS IN THE NORTH EASTERN HILL REGION

Livelihood Assessment of Households in Wetland of Manipur: A Micro-Level Study

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ABSTRACT

The Convention on Wetlands of International Importance known as Ramsar Convention was held at Denmark with an objective to protect and conserve wetlands' ecosystem dependent upon it. The North Eastern Hill Region (hereafter; NEHR) of India is also a home to three Ramsar sites, viz., Deepor Beel in Assam, Loktak lake in Manipur and Rudrasagar in Tripura. It has been reported that people of Manipur are socially, economically, culturally and ecologically linked with the Loktak lake. It has been the source of water for domestic uses, generation of hydro-electric power, irrigation, habitat for several plants used as food, fishing ground for local people, fodder, fuel, medicines, biodiversity, recreation, etc. In the above context, the present study has aimed to assess the livelihood of households in wetland of Manipur and also to identify the determinants of livelihood strategy on the basis of livelihood assets. Primary data were collected from four villages under Moirang block of Bishnupur district. Livelihood assessment framework comprising human, physical, financial and social assets indicators were estimated. The households were then classified based on the estimated indices. Furthermore, multinomial logistic regression model was applied to understand the determinants of livelihood strategy on the basis of different livelihood assets. It was reported that maximum number of the households has moderate human (44.44 per cent), financial (44.44 per cent) and social assets (39.68 per cent). However, 42.86 per cent of the households were having low physical assets. Overall, 46.03 per cent of the households has moderate livelihood assets, followed by high livelihood assets (30.16%) and 23.81 per cent of the households belong to low livelihood assets. Moreover, the households' livelihood in Ramsar site Loktak, were characterised based on four different components and it has been found that 100 per cent households engaged themselves in Component-1, 47.62 per cent in Component-2, 42.86 per cent in Component-3 and 9.52 per cent in Component-4. The multinomial logistic regression model estimated further explained that financial assets were the most important asset in adopting the livelihood strategies whereas; social assets could increase the chance of adopting other livelihood strategies apart from fishing in the study area. The study concluded that proper management strategy of the area by the Government of Manipur has to be encouraged along with in depth research, interventions, action plans, proper monitoring and evaluation by different universities like Central Agricultural University (Imphal), Central University (Manipur) and other government and non-governmental organisations. Loktak Lake is a base for ecological and economic security, thus payments for ecosystem services for sustainable water management has to be encouraged and implemented.

I

INTRODUCTION

Wetland has been of unique significance with the existence of the Convention held on February 2nd, 1971 on Wetlands of International importance

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especially, Waterfowl Habitat (the Ramsar Convention) in Denmark. It is the only global convention with an objective to protect and conserve the particular type of eco system and the flora and fauna dependent upon it (IUCN, 1989). It is also an international treaty for the conservation of and sustainable utilisation of wetlands, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value (Government of India, 2022). The total numbers of Ramsar wetland sites as on February 2022 in India were reported to be 11650.55 km square of which, 308.4 sq km is located in the Northeastern Hill Region (NEHR) of India. The Ramsar wetland sites in NEHR includes the Deepor Beel in Assam, Loktak lake in Manipur and Rudrasagar in Tripura (SANDRP, 2020) which were officially designated as Ramsar on the 19th August 2002, 23rd March 1990 and 8th November, 2005, respectively.

Loktak Lake which is the Ramsar site of Manipur has been identified as one of the sites for conservation under Indian National Wetland Programme. It has been regarded as the largest natural wetlands in the NEHR and covers an area of 287 km^2 and has an average height of 800–2070 m above the mean sea level (WISA and LDA, 2004). It has a direct catchment area of 1040 km^2 where 35 per cent, 15 per cent and 50 per cent is under agriculture, under settlement and forest cover, respectively. The indirect catchment area covers an area of 7157 km^2 (which includes the catchment of five important rivers, viz., Imphal, Iril, Thoubal, Sekmai and Khuga) (Anon, 2003). The lake has been broadly divided into three zones, viz., central, northern and southern zone, on the basis of vegetation type, *phumdi* thickness, drainage network, open water area location and human activity (Santosh and Bidan, 2002; Kangabam and Munisamy, 2017). It has been reported that people of Manipur are socially, economically, culturally and ecologically associated with the lake. The lake has been the source of water for domestic uses, generation of hydro-electric power, irrigation, habitat for several plants used as food, fishing ground for local people, fodder, fuel, medicines, biodiversity, recreation (Singh and Khundrakpam, 2011; Ram *et al.*, 2013). The lake is the breeding ground for a number of riverine fishes and continues to be a vital fisheries resource. Fishing remains as the primary source of livelihood to the fishermen (Devi *et al.*, 2012). The lake plays an important role in providing ecological and economic security to the region. A large population living in and around the lake depend on its resources for their sustenance (Leisangthem *et al.*, 2012). Thus, the lake has been referred to as the 'lifeline of Manipur' (Kangabam *et al*., 2015; Kangabam and Munisamy, 2017). Keeping in view the importance of the lake, a study was taken up with the following major objectives: (1) To assess the livelihood of households in wetland (Ramsar site) of Manipur and (2) To identify the determinants of livelihood strategy on the basis of livelihood assets.

The paper is organised as follows. Section II describes the materials and methods used in fulfilling the objectives of the study. The results obtained are reported and discussed in Section III. Section IV concludes the study by summarising the findings and also suggest some suitable policy measures.

II

MATERIALS AND METHODS

The study was conducted in Moirang block of Bishnupur district, Manipur which is the waterfront of Loktak lake. From the selected block, Thamnapokpi, Thanga, Ithing and Karang villages were selected randomly. A total of 63 households were selected randomly from across the selected villages for the study.

2.1 *Data*

Primary data on socio-economic variables, fish production, and availability of fish, drinking water, access to government schemes, loans etc., were collected from the respondents using the pre-tested and structured schedule through personal interview of the households.

2.2 *Analytical Techniques*

2.1.1 Indicators of Livelihood Assets

Livelihood assessment framework comprised four assets namely; human, physical, financial and social assets (Yang *et al*., 2018). The details about the indicators are given in Table 1.

(a) Human Assets: It includes those indicators relating to the skills, knowledge and experience possessed by an individual or family which enhances the adaptive capacity and increases the available livelihood options.

(b) Physical or Natural Assets: It includes all the assets owned by an individual such as land, livestock, infrastructure, machinery etc., which are used by an individual or farmer for his agricultural production and livelihood. It also includes all his property and ownership.

*(c) Financial Assets***:** It includes the individual's financial assets like income from agriculture and other employment opportunities.

*(d) Social Assets***:** It includes all the indicators which are related to the association of an individual with one another or with different institutions in gaining knowledge about the day to day activities related to weather, fishing, technical ideas etc. Through this association and relationship, the individual is able to share and learn about their past and present strategies so as to increase their adaptive knowledge and capacity for the future.

2.1.2 Normalization of Data

The values of different indicators were normalized so as to bring their values under a suitable range (*i.e.*, 0-1) and render it as a dimensionless measure or number, (Feroze *et al.*, 2014). It was done by subtracting the minimum value from the observed value.

TABLE 1. TYPES OF ASSETS FOR LIVELIHOOD ASSESSMENT AND THEIR INDICATORS

Type (1)	Indicator Name (2)		Indicator definition (3)
Human assets	Age		Actual number
	Gender		Male= 0 Female= 1
	Education		Illiterate- 1, Literate without formal schooling- 2, Literate but below primary- 3, Primary- 4, Middle - 5, Secondary- 6, Higher secondary - 7, Diploma/Certificate course - 8, Graduate- 9, Post Graduate and above - 10.
	Family size		Actual number
	No. of Earners		Actual number
	Time Spent	Fishing Fetching water	Hours/day
	Dwelling Structure	*Kaccha* *Semi-Pucca* *Pucca*	Percentage of Household
Physical assets	Fish Pond		ha
	Cattle Poultry Pig		Actual number
	Fishing implements		
	Availability of drinking water from loktak		(Decrease=0, Increase=1, Normal=2)
	Availability of fish		
Financial Assets	Income from fisheries/month		₹
	Income from fisheries and weaving		
	Income from fisheries, weaving and Government Schemes		
	Other sources of income		Yes = 1 No = 0
	Employment Generation Schemes		
	Formal Loans		Yes= 1 No= 0
	Informal loans		
Social assets	Distance of HH from Market		km
	Access to info from Fishery department		Yes= 1 No= 0
	ICT related information		
	ITKs		

Source: (Nongbri *et al*., 2016 (modified); Yang *et al*., 2018)

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$$S_i(\text{normalised}) = (S_i - S_i \min)(S_i \max - S_i \min) \quad \ldots (1)$$

$$S_i(\text{normalised}) = S_i \max - S_i S_i \max - S_i \min \quad \ldots (2)$$

Where, S_i is the i-th indicator value.

Equation (1) was used for the variables with positive effect and equation (2) was used for the variables with negative effect. Normalization was done so as to aggregate and categories the farming households according to their livelihood.

2.1.3 Assigning of Weights

The indicators after normalization were aggregated with appropriate weights to obtain the index (I).

$$Wj = \frac{C}{\sqrt{Variance\ Si}} \quad \ldots. (3)$$

Where, C= $Wj = \frac{1}{\frac{1}{\sqrt{Var\,Si}}+\frac{1}{\sqrt{Var\,S_2}}\ldots\ldots\ldots+\frac{1}{\sqrt{Var\,Sik}}}$

(Iyengar and Sudarshan, 1982)

The weights were multiplied with their respective normalized indicator values and summed them up to get the indices.

$$Y=W_{1Si}+W_{2Si}+.....+Wj_kS_{ik} \quad .... (4)$$

Where, 'Y' is human, physical, financial and social assets.

The households were classified based upon the estimated indices for human, physical, financial and social assets by calculating cumulative square root of the frequencies.

For distribution of respondents based on livelihood assets different units were adopted, i.e., number of years, percentage, hectare, rupees, actual number and number of hours per day spent on different activities (Table 2,3,4 and 5).

2.2 *Multinomial Logistic Regression Model*

To identify the determinants of livelihood strategy on the basis of livelihood assets, the selected livelihood strategies were subjected to discrete choice modelling using multinomial logistic regression. The multinomial logit model is preferred when the dependent variable has multiple categories and is unordered. The multinomial logistic regression model specifies that

$$P_{ij} = \frac{Exp(X_j'\beta_j)}{\sum_{i=1}^{m} \text{Exp}\ (X_j'\beta_j)} j=1\ldots\ldots..m$$

Where P_{ij} represents the possibility of household in choosing livelihood strategy j out of m strategy, X_i represents factors that influence household livelihood strategy selection including livelihood assets. To ensure model identification, β_j was set to zero for one of the categories, and the coefficients were then interpreted with respect to that category, also known as the base category.

III

RESULTS AND DISCUSSION

3.1 Livelihood of households in wetland (Ramsar site) of Manipur

3.1.1 Livelihood Indicators of Livelihood Assets

Human Assets

Age of the household emerged as a strong indicator of human index. Greater the age signifies the experience of the household head in fishing and other general knowhow regarding Loktak lake. About 84.13 per cent of the respondents were reported to be male and 15.87 per cent were females. The majority of the respondents completed their middle school (34.92 per cent) and 14.29 per cent of them were graduates. Leisangthem *et al.* (2012) reported that maximum of the local communities of Loktak lake were educated below high school. The family size was reported to be five members with an average of two earning members per households.

It has also been found that male members spent 7.63 hours per day in fishing while their female counterparts spent only 2.41 hours per day. The main reason was that fishing was a laborious and male-oriented work mainly executed by the men folk. Women spent their time in drying and selling of the fish catch in their homes. When it comes to fetching water, men did help their family with an average of 0.30 hr per day and females spent only 0.22 hr per day in collecting water for drinking (Table 2). The women folks also engaged themselves in execution of different household chores.

TABLE 2. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR HUMAN ASSETS

Sub indicator / Variable (1)			Unit (2)	Average value (3)
Average Age			Years	49.03
Gender	Male			84.13
	Female			15.87
Education	Illiterate- 1		%	9.52
	Literate without formal schooling- 2			0.00
	Literate but below primary- 3			3.17
	Primary- 4			14.29
	Middle - 5			34.92
	Secondary- 6			9.52
	Higher secondary - 7			4.76
	Diploma/Certificate course - 8			4.76
	Graduate- 9			14.29
	Post Graduate and above - 10			4.76
	Family size		Actual number	5.00
	No. of Earners			2.00
Time Spent	Fishing	Male	hr/day	7.63
		Female		2.41
	Fetching water for drinking	Male		0.30
		Female		0.22

Physical Assets

About 47.62 per cent of the households owned kaccha houses while 42.86 per cent owned semi-pucca houses and only 9.52 per cent owned pucca houses. This finding comprehends the findings of Laishram and Dey, (2013) and Bharati et al., (2017). Some households (23.81 per cent) owned fish ponds with an average of 0.81 ha where harvest used to be made once or twice a year based on the family needs for selling or consumption. The respondents reported that they have at least 5 number of fishing implements including boats for fishing. The households owned on an average 5 cattles, 25 numbers of poultries and 5 numbers of pigs, designated them as their supplementary during time of need. The households expressed their concern regarding the construction of dam which has led to the submergence of their agricultural lands. As a result, fishing remained the major source of livelihood in the area.

The households were questioned about the availability of drinking water from Loktak and the quality of water, where, a maximum (53.97 per cent) perceived that there was no change in the availability of water. However, 46.03 per cent perceived that the availability of drinking water has decreased which was due to pollution. The pollution scenario has risen due to dumping of waste materials from the nearby towns, tourist and hospital wastes etc. When asked about the availability of fish in the lake, the respondents (93.65 per cent) reported that fish's availability has decreased over the years and 7.94 per cent responded that there was change. Laishram and Dey, (2013) also reported the declining of natural resources in the Loktak lake. The decrease in the fish availability was due to construction of dams, eutrophication and water quality deterioration. Singh (1993) and Khoiyangbam (2021) reported that construction of the Ithai barrage blocked pathways of fishes, leading to a decline in their population and ultimately disappearance of fishes and migratory fishes.

TABLE 3. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR PHYSICAL ASSETS

Sub indicator / Variable (1)		Unit (2)	Average value (3)
Dwelling Structure	*Kaccha*	Per cent	47.62
	Semi-Pucca		42.86
	Pucca		9.52
Fish pond		ha	0.81
Cattle		Actual number	6.00
Poultry			25.00
Pig			6.00
Fishing implements			5.00
Availability of drinking water		No change	53.97
		Decrease	46.03
Availability of fish		No change	7.94
		Decrease	93.65

Note: kaccha-: The walls or roof are made of either burnt bricks, bamboos, mud, grass, reeds, thatch, loosely packed stone; Semi-pucca*: The walls and roof are made of burnt bricks, stones (packed with lime or cement), cement concrete and timber*.

Financial Assets

It has been reported that most of the households earned their income from fisheries sector with an average monthly income of ₹11227.59. Apart from that, households earned their livelihood from other subsidiary occupation like weaving, business and other sources of income. The households were also the beneficiaries of Government Schemes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). In terms of issuing and availing of loans by the fish farmers in the study area, it has been found that only 1.59 per cent in terms of formal loans and 7.94 per cent informal loans (Table 4). The loans availed were mainly utilised for purchasing of fish inputs, fish implements and other related items.

TABLE 4. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR FINANCIAL ASSETS

Sub indicator / Variable (1)	Unit (2)	Average value (3)
Income from fisheries/month	₹	11227.59
Income from fisheries and weaving		12330.76
Income from fisheries, weaving and Government Schemes		21831.77
Other sources of income		24477.73
Employment Generation Schemes		1061.28
Formal Loans	Per cent	1.59
Informal loans		7.94

Social Assets

The average distance of households to main market for marketing and other market related activities was reported to be 5.97 km. In relation to access to access to information from Fishery department, only 17.46 per cent of the households have regular and proper access. The mass populations are not equipped to different important information from the department concern. However, 65.08 per cent reported that maximum information was extracted from mobile phones through YouTube regarding their daily activities and general knowledge regarding fishing and fishing culture. With regards to Indigenous Traditional Knowledge (ITK), 44.44 per cent of the households reported that they are availing them. Devi *et al.* (2012) reported that fishers have rich traditional knowledge regarding fishing and fishing culture. ITKs were mainly from the elders, neighbours and friends (Table 5). The households reported that information through newspapers were not common and up to date as there were no proper services available for accessing them.

TABLE 5. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR SOCIAL ASSETS

Sub indicator / Variable (1)	Unit (2)		Average value (3)
Distance of HH from Market	km		5.97
Access to information from Fishery department	Yes= 1 No= 0		17.46
ICT related information	Yes= 1 No= 0	%	65.08
ITKs	Yes= 1 No= 0		44.44

3.1.2 Livelihood Assets

It has been found from the study that that maximum of the households (44.44 per cent) has moderate human assets. Maximum of the households have low and moderate assets with 42.86 per cent and 44.44 per cent. The households have moderate social assets with 39.68 per cent followed by high social assets with 30.16 per cent respectively.

Overall, the livelihood assets of the households were calculated which indicated that 46.03 per cent of the households have moderate livelihood assets followed by high livelihood assets with 30.16 per cent and 23.81 per cent of the households belong to low livelihood assets (Table 6).

TABLE 6. CATEGORISATION OF HOUSEHOLDS BASED ON DIFFERENT ASSETS

Category (1)	Class (index value) (2)	Mean index value (3)	Frequency (per cent) (4)
Human Asset			
Low	<0.43	0.37	28.57
Moderate	0.44-0.54	0.49	44.44
High	>0.55	0.60	26.98
Physical Asset			
Low	<0.21	0.17	42.86
Moderate	0.22-0.32	0.25	38.10
Moderate	>0.33	0.38	19.05
Financial Asset			
Low	<0.15	0.08	36.51
Moderate	0.16-0.29	0.21	44.44
High	>0.30	0.43	19.05
Social Asset			
Low	>0.33	0.24	38.10
Moderate	0.34-0.53	0.40	39.68
High	>0.54	0.65	22.22
Livelihood			
Low	>0.55	0.44	23.81
Moderate	0.56-0.71	0.65	46.03
High	>0.71	0.76	30.16

3.1.3 Distribution of Households Based on the Different Components

The households' livelihood in Ramsar site Loktak, were characterised based on four different domains or components viz., fish (component-1), fisheries and weaving (component-2), fisheries and government schemes (component-3) and fisheries along with other sources of income (component-4). It has been found that every household were engaged themselves in component-1, 47.62 per cent in component-2, 42.86 per cent in component-3 and 9.52 per cent in component-4 which included business like shops and transportation.

Figure 1 depicts that component-1 has higher human assets compared to the other components which can be explained in chronological order viz., component-3, component-2, and component-4. Similarly, it can be seen that physical assets are

equally distributed across different components. Maximum of the households across different components depends their livelihood on financial assets with component-1 having the highest contribution followed by component-4, component-2 and component-3. In terms of social assets, it has been found that component-1 has higher social index followed by component-3, component-2 and component-4, respectively. This signifies that maximum of the households depends on fishing as their main livelihood component or domain in the study area (Figure 1).

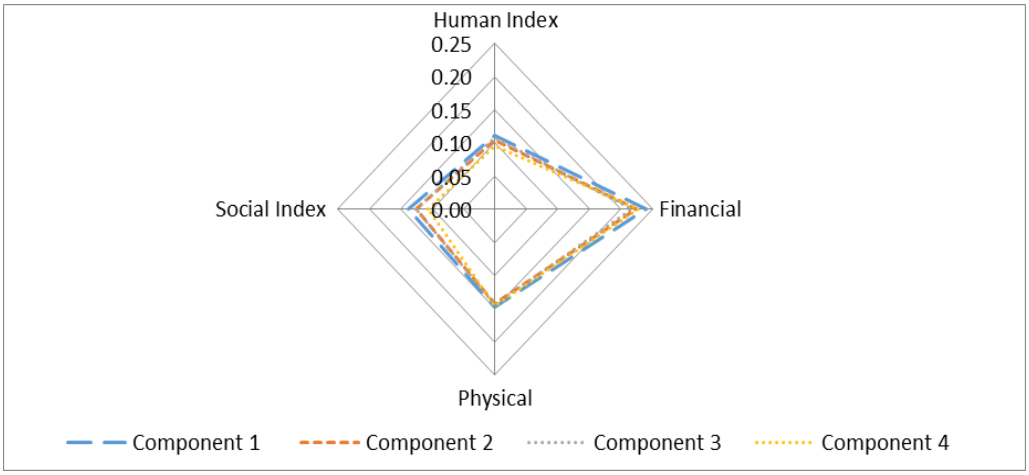

Figure 1. Distribution of Households Across Different Assets

3.2 Determinants of Livelihood Strategy

To determine the influence of human, social, physical, financial, and natural assets on livelihood strategies, a multinomial logit regression was estimated. The goodness of fit for the multinomial logit was tested and found that the value was 107.417 significant at 1 per cent, thus indicating a high goodness of fit (Table 7). The results indicated that the model is consistent, and the estimated results are stable and credible. The model showed that livelihood assets explained approximately 66 per cent of the variance of dependent variables (Cox and Snell = 0.664). This means that livelihood assets assume significant importance in adopting different livelihood strategies.

The influence of livelihood assets on the livelihood strategies was analysed based on the coefficient and odd-ratio values. The coefficients reflect the effect of the assets on the probability of adopting Component-2, Component-3 and Component-4 strategies relative to the fishery only as the reference category.

The odd-ratio values reflect the degree the probability of the adoption of each strategy changes in relation to the base strategy, if a household's access to certain assets changes by one unit. The results revealed that one unit increase in households'

possession of financial assets will increase the probability of adopting component-2, component-3 and component-4 strategies by 1.00 times respectively (Table 7). This finding corresponded with the findings of Pour *et al*. (2018).

Financial assets were the most important assets in adopting the livelihood strategies. Interviews with the informants revealed that respondents under the component-1 availed the credit from both the formal and informal sources for buying the fishing boats and other fishing implements. Respondents from the other livelihood components did not avail any credits from either source. This finding revealed that the household becomes more stable as they engaged in other income generating sectors. Therefore, increasing financial assets would facilitate engagement in other livelihood strategies, including businesses and self-employment.

Social asset was another livelihood asset which increases the chance of adopting other livelihood strategies apart from fishing in the study area. Households with higher social assets were more inclined to choose other livelihood component strategies. It was evident from Table 7 that one-unit increase in social asset of households is likely to increase the chance of adoption of component-3 and component-4 by 2.63 and 2.71 times respectively. This finding coincides with the findings of Pour *et al*. (2018). Thus, increasing the social assets among the households should be considered as an important policy intervention so as to enable them to participate in other livelihood strategies.

Livelihoods depending only on fishing are not sustainable. Hence, intervention from other sectors like handloom industries, fishery industries in the area so that the livelihood of the household will be more secured.

TABLE 7. DETERMINANTS OF LIVELIHOOD STRATEGY

Assets	Component-2			Component-3			Component-4		
	Co-efficient	p-value	Exp (β)	Co-efficient	p-value	Exp (β)	Co-efficient	p-value	Exp (β)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Human asset	-0.061	0.329	0.941	-0.066	0.309	0.936	-0.039	0.573	0.961
Financial asset	.000***	0.005	1.000	.000***	0.001	1.000	0.000***	0.001	1.000
Physical asset	0.102	0.372	1.107	0.115	0.402	1.101	0.063	0.594	1.066
Social asset	0.782	0.130	2.186	0.527*	0.066	2.633	0.999*	0.073	2.716

Note: ***and * indicate level of significance at 1 and 10 per cent respectively.
Model Information: Fishery is the base livelihood strategy.
Chi-Square =107.417; DF = 10; Sig = 0.000. Pseudo R-square: McFadden = 0.420; Nagelkerke = 0.717; Cox and Snell = 0.664

IV

CONCLUSION AND POLICY IMPLICATION

One the basis of the collected primary data *viz*., households level survey, the livelihood assessment was divided into human, physical, financial and social asset. The assessment was analyzed based on the different assets by categorization and determination of the different factors affecting the livelihood. It can be concluded that maximum of the households has moderate human assets while most of them have low to moderate physical and financial assets. With regard to social assets, maximum of the households belongs to moderate and high category. The multinomial logistic model further revealed that financial assets were the most important assets in adopting the livelihood strategies and social asset is another livelihood asset which increases the chance of adopting other livelihood strategies apart from fishing. Hence, financial asset has to be made secured in order to sustain the livelihood of the households as the wetland of Manipur is an economic zone. Moreover, with better social assets, the households would be able to accommodate more knowledge regarding fishing and allied activities as these sectors being the major occupation. Proper guidance and interventions from sectors like handloom by the concerned department, post-harvest facilities for fishes by Fishery department etc. have to be adopted with advanced and equip technologies regarding value addition. The latter recommendation has also been highlighted by Meitei *et al*., 2019.

Thus, proper management strategy of the area has to be encouraged by the Government of Manipur so as to adhere proper services for lifelong and sustainable livelihood. This will include water management, catchment conservation, livelihood improvement programmes through awareness from home, schools and public domains. Moreover, different universities like Central Agricultural University (Imphal), Central University (Manipur) and other Government and Non-governmental organizations has to adopt in depth research, action plans, proper monitoring and evaluation in the area for the well-being of wetland and its inhabitants. As Loktak Lake which is the only Ramsar site in Manipur was found to be multifunctional as it provides the base for ecological and economic security, for the people residing around it, measures like payments for ecosystem services for sustainable water management must be encouraged for further implementation.

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